Valuing Chronic Morbidity Damages:

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W. Kip Viscusi
Northwestern University
EPA Cooperative Agreement
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Wesley Magat and Joel Huber
Duke University
EPA Cooperative Agreement
CR-814388/01-0

Project Officer: Dr. Alan Carlin

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Executive Summary

1. This study obtained valuations of severe cases of chronic bronchitis (CB) using an interactive computer program that elicited key tradeoff rates using paired comparisons until a point of indifference was reached.
2. The methodology focused primarily on risk-risk tradeoffs in which CB-auto accident fatality risk tradeoff rates were obtained. Various risk-dollar tradeoffs were also obtained.
3. The sample consisted of almost 600 shoppers from Greensboro, N.C.
4. An important component of the study involved education of the participants with respect to the health implications of CB and the disutility they would experience because of the disease.
5. Using two different approaches to eliciting tradeoffs based on a death risk scale, respondents gave a median response that the CB avoidance value was equivalent to 0.23 and 0.32 of a comparable risk of death, with mean responses 0.61 and 0.68 times the risk of death.
6. Whereas risk-dollar tradeoff questions often exhibit large fluctuations reflecting limitations on individual rationality, such as substantial divergences between the buying prices and selling prices for risk, the risk-risk tradeoffs displayed only minor changes with respect to the questionnaire structure.
7. The dollar valuation of CB using the risk-risk tradeoffs varies depending on the reference value of life number, thus assuring a consistent relation among the valuation of health outcomes. With a $2 million value of life, the median CB value is from $460,000 to $640,000, and the mean CB value ranges from $1,220,000 to $1,360,000. For reference value of life numbers such as $3 million and $5 million the CB

values are scaled up proportionally (see Table 11).

8. The value of life numbers implied by the CB/Cost of Living tradeoffs had a median value of $2.3 million and a mean value of $8.2 million. The mean value was greatly affected by response outliers.

9. The CB/dollar tradeoff questions yielded CB values comparable to the risk-risk values that are converted into dollar terms using a $2 million value of life. The CB/Cost of Living median value was $457,000, and the CB/Storm Damage median CB values ranged from $533,340 to $800,000. The mean values were roughly double the median (see Table 11).

10. About one-third of the respondents gave inconsistent answers or failed to converge to a tradeoff rate. About half of these cases appear due to systematic problems with other tradeoff questions as well, and the other half appear to be largely random in nature.

1. Introduction

Over the past decade economists have devoted substantial attention to the implicit valuation of health outcomes. These analyses of risk-dollar trade-offs have relied in large part on market-based data (see Viscusi (1986) for a review of the market tradeoff literature). For example, wage-risk tradeoffs have been used to analyze the implicit value of fatalities. Similarly, economists have analyzed the tradeoffs implied by seat-belt usage decisions to infer a value of life. Similar valuations have been obtained for the average nonfatal job accident risk.

Although studies using market data provide useful benchmarks for health risk valuation, they do not resolve the issue of how government agencies should attach benefit values to health outcomes for which we do not have good market data. This omission is particularly important for government agencies such as EPA which generally focuses on policy contexts in which market forces are believed to be not fully effective. For these situations, no useful market tradeoff data may be available. Some progress has been made in addressing these benefit issues using non-market techniques, such as contingent valuation, to elicit stated willingness-to-pay values.

The focus of this report differs from existing work in two ways. First, the health outcome that we consider is chronic bronchitis rather than an acute health effect, such as an accidental death. Chronic bronchitis is an important morbidity benefit component for EPA air pollution policies. Because of the complex nature of the health effects, a substantial portion of the survey was devoted to communicating the character of this illness to the respondents.

The second novel feature pertains to the structure of our survey. We utilized an interactive computer program to ascertain the points of

indifference for tradeoffs involving chronic morbidity risks and several attributes (cost of living, storm damage, and automobile fatalities). These different approaches provide several internal consistency checks and provide a methodology that is potentially less susceptible to respondent bias and policy controversy. In particular, by using risk-risk tradeoffs policymakers can convert all health outcomes into fatality risk equivalents, reducing the range of health outcomes that need be accorded an explicit dollar value. Respondents may also be able to give more meaningful responses to comparisons of health risks than to explicit questions about risk-dollar tradeoffs. The similarity of the implied valuations for chronic morbidity across survey approaches and the general comparability of the survey's value-of-life responses to those in the literature suggest that the methodology used here can be successfully applied to other morbidity outcomes.

The outline of this report is as follows. Section 2 provides an overview of the study design and the sample. Section 3 describes the risk-risk trade-offs whereby respondents put their chronic morbidity valuations into auto death equivalents. In Section 4 we describe the direct estimates of risk-dollar tradeoffs for chronic bronchitis obtained by asking respondents to trade off chronic bronchitis risks with either the area's cost of living or property damage from storms. As a check of the validity of the approach, we provide evidence on auto fatality risk-dollar trade-offs in Section 5. These implicit value of life numbers should be comparable to those in the literature if the survey approach is valid. In Section 5 we also convert all of our results to dollar equivalents. In Section 6 we analyze differences in response rates to the different questionnaires, and Section 7 discusses the

variation in the valuations with different personal characteristics. Section 8 concludes the report discussion, and the Appendix provides the text of the three questionnaires.

2. Study Design and Sample Description

Methodology

The task of eliciting individuals' valuation of chronic bronchitis is not straightforward. The first problem is that few individuals fully understand the health effects of chronic bronchitis. Second, once given this information, they may not have sufficient experience in dealing directly with such tradeoffs to give meaningful valuation responses. To accommodate these difficulties we developed an interactive computer program that would inform consumers as well as elicit tradeoff information.

Three different questionnaires were used, but for concreteness let us focus on what we will designate Questionnaire A. After acquainting the respondent with the computer, the program elicits information regarding the respondent's personal characteristics (e.g., age). A substantial portion of the questionnaire (about 40 questions) is then devoted to acquainting the respondent with the health implications of chronic bronchitis and the nature of the tradeoffs that would be encountered. These questions elicit the respondent's familiarity with chronic bronchitis, information on smoking history, and provided a detailed summary of the health implications of chronic bronchitis.

These thirteen health implications of chronic bronchitis are summarized in Table 1. Since there is no standardized chronic bronchitis case, our analysis focused on the most severe chronic morbidity effects, including

Table 1

Health Implications of Chronic Bronchitis

1. Living with an uncomfortable shortness of breath for the rest of your life.
2. Being easily winded from climbing stairs.
3. Coughing and wheezing regularly.
4. Suffering more frequent deep chest infections and pneumonia.
5. Having to limit your recreational activities to activities such as golf, cards, and reading,
6. Experiencing periods of depression.
7. Being unable to do the active, physical parts of your job.
8. Being limited to a restricted diet.
9. Having to visit your doctor regularly and to take several medications.
10. Having to have your back mildly pounded to help remove fluids built up in your lungs.
11. Having to be periodically hospitalized.
12. Having to quit smoking.
13. Having to wear a small, portable oxygen tank.

emphysema. Since a quick overview of these effects may not be fully comprehended by respondents, in each case subsequent questions ascertain the respondents' assessed disutility ranking of each outcome on a linear 49 point scale. The purpose of these questions is not to establish attribute-based utilities, but to encourage respondents to begin the process of thinking carefully about the health implications of chronic bronchitis and their own view of the effect of this disease on their well-being.

Respondents then confront the first of three tradeoffs. Individuals are presented with a choice of moving to one of two alternative locations, which differ in terms of their chronic bronchitis risk and auto accident risk. To ensure that respondents would be willing to consider making such a move at all, they were told that these locales posed a lower risk of both outcomes than their current place of residence.

Since risk levels differ across individuals, the program elicits information regarding individual activities that are likely to influence their person-specific risk, such as smoking habits and mileage driven per year. The program then informs the respondents that the probabilities presented in subsequent questions are calculated based on their responses to the earlier risk-related activity questions, even though the same risks are actually presented to all subjects. This procedure increases the extent to which the stated risk levels are taken at face value, while facilitating the comparison of risk tradeoffs across subjects because they all responded to the same risks.

To ensure that respondents understood the task, they are first presented with a dominant choice situation. Let the notation (x,y) denote a locale

where the chronic bronchitis probability is x/100,000 and the auto accident death risk is y/100,000. The actual survey did not present the choices in such abstract terms, but this notation makes the exposition of the survey structure simpler. (For an example, see Question #49 of Questionnaire A in the Appendix.) Our past studies suggest that presenting the risk in terms of the number of cases for a large base population is more comprehensible than giving risk levels such as 0.00075.

To ascertain whether respondents understood the task, they are first asked whether they prefer Area A with risks per 100,000 population of (75, 15) or Area B with risks (55, 11). Since each of the Area B risks is lower, this alternative is dominant. Respondents who do not comprehend the task and answer incorrectly are sent through a series of questions that explain the structure of the choice in more detail.

The performance with respect to the dominance question was quite good. Eighteen percent of the sample did not answer the dominance questions correctly on their initial attempt, so that over four-fifths gave a correct response. After being given additional information, fewer than 1 percent of the subjects gave an incorrect answer, and these respondents were excluded from the sample since they did not understand the interview task.

The survey then proceeds with a series of pairwise comparisons in which the attributes are altered based on the previous responses until indifference is achieved. Consider the following model of state-dependent utilities. Let subscripts a denote Area A and b denote Area B. Also, let U(CB) be the utility of a case of chronic bronchitis, U(D) equal the utility of an auto accident death and U(H) equal the utility of being healthy (i.e., having

neither CB nor an auto accident), To simplify this exposition we assume that contracting CB and dying from an automobile accident are mutually exclusive events. Also let X_a denote the probability x/100,000 for Area A and Y_a denote the probability y/100,000 for Area A, and similarly for X_b and Y_b. The survey continually modified the choice pairs until subjects reached the situation where

$$(1)\quad (X_a)U(CB) + (Y_a)U(D) + (1 - X_a - Y_a)U(H) = X_bU(CB) + Y_bU(D) + (1 - X_b - Y_b)U(H).$$

Our general objective is to establish the death risk equivalent of chronic bronchitis. If we assume for concreteness that $X_a > X_b$ and $Y_b > Y_a$ (no loss of generality),

$$(2)\quad (X_a - X_b)U(CB) = (Y_b - Y_a)U(D) + (X_a - X_b + Y_a - Y_b)U(H),$$

or

$$(3)\quad U(CB) = \frac{Y_b - Y_a}{X_a - X_b}U(D) + (1 - \frac{Y_b - Y_a}{X_a - X_b})U(H).$$

If we define the rate of trade-off between CB and D as t_1, so that

$$(4)\qquad t_1 = \frac{Y_b - Y_a}{X_a - X_b},$$

we obtain the result that

$$(5)\qquad U(CB) = t_1U(D) + (1-t_1)U(H).$$

The utility of CB cases has been transformed into an equivalent lottery on life with good health and death, for which we have a well-developed literature.

Consider the first paired comparison in Questionnaire A, which is summarized in Table 2. In this case, respondents are given the choice between Area A with risks (75, 15) and Area B with risks (55, 19). For

Table 2

Summary of Survey Structure

Questionnaire A

Trade-Off	Units of Measurement	Procedure
1. Chronic bronchitis - auto deaths	Auto deaths per chronic bronchitis case	Increase the bronchitis risk of the area with the higher auto accident risk, lower bronchitis risk until reach indifference
2. Chronic bronchitis - auto deaths	Auto deaths per chronic bronchitis case	Reduce the bronchitis risk of the area with the lower auto accident risk, higher bronchitis risk until reach indifference
3. Chronic bronchitis - cost of living	Dollar value per l/100,000 reduced risk of bronchitis	Increase the bronchitis risk of the area with the lower bronchitis risk, higher cost of living until reach indifference.

Questionnaire B

1. Chronic bronchitis - storm damage	Reduced probability of $2000 storm damage that is equivalent to one bronchitis case prevented	Increase the bronchitis risk of the area with the lower-chronic bronchitis risk, higher storm damage risk until reach indifference.
2. Chronic bronchitis storm damage	Probability of $2000 storm damage equivalent to one bronchitis case	Reduce the bronchitis risk of of the area with the higher bronchitis risk, lower storm damage risk until reach indifference.

Table 2 (cont'd)

Summary of Survey Structure

Trade-Off	Units of Measurement	Procedure
Questionnaire C		
1. Same as Questionnaire A - Part 1		
Chronic bronchitis - auto deaths	Auto deaths per chronic bronchitis case	Increase the bronchitis risk of the area with the higher auto accident risk, lower bronchitis risk until reach indifference.
2. Same as Questionnaire B - Part 2		
Chronic bronchitis - auto deaths	Auto deaths per chronic bronchitis case	Reduce the bronchitis risk of the area with the lower auto accident risk, higher bronchitis risk until reach indifference.
3. Auto accidents - cost of living	Dollar value per 1/100,000 reduced risk of an auto accident	Increase the auto accident risk of the area with the lower auto accident risk, higher cost of living until reach indifference.

concreteness, suppose that Area B is preferred in this example. Area B has the higher auto accident risk and lower chronic bronchitis (CB) risk. The program subsequently raises the CB risk in the preferred Area B until indifference is achieved.

Suppose, for example, that the respondent views the risk pair (75, 15) as being equivalent to (65, 19). Using equations 4 and 5 above, we have the result that

$$t_1 = \frac{19 - 15}{75 - 65} = 0.4,$$

and

$$U(CB) = 0.4U(D) + 0.6U(H).$$

The second portion of Questionnaire A is identical except that Area A now poses a lower CB risk and higher auto risk than Area B. In this example Area A is initially preferred to Area B. The initial risk pairs are (75, 15) for Area A and (95, 11) for Area B. To achieve indifference, the CB risk in Area B is lowered until indifference is achieved. Since $X_b > X_a$ and $Y_b < Y_a$ at the indifference point in this situation, the analog of equation 2 is

$$(6) \quad (Y_a - Y_b)U(D) + (X_b - X_a + Y_b - Y_a)U(H) = (X_b - X_a)U(CB),$$

or

$$(7) \quad U(CB) = \frac{Y_a - Y_b}{X_b - X_a} U(D) + \left(1 - \frac{Y_a - Y_b}{X_b - X_a}\right) U(H).$$

If we let the trade-off rate be t_2, or

$$(8) \quad t_2 = \frac{Y_a - Y_b}{X_b - X_a},$$

Then we have as before

$$(9) \quad U(CB) = t_2U(D) + (1 - t_2)U(H).$$

The tradeoff rates, t_1 and t_2, need not be identical. Although there are some formal economic reasons for a minor difference (e.g., differences in base risk levels), a potentially more important factor is related to differences in buying and selling prices that have been observed in the literature for risk-dollar trade-offs (see Viscusi, Magat, and Huber (1987)). The structure of the questions, which is summarized in Table 3, involves an increase in the CB risk in order to reach indifference in the case of Part 1 and a decrease in the CB risk to reach indifference in Part 2. If individuals perceive risk increases as being more consequential than risk decreases, then the $(X_a - X_b)$ gap that is in the denominator of t_1 should be larger than if no bias in perceptions were present. Thus, the observed rate of trade-off tl should be below t_2 if there were a bias in perceptions based on whether the risk was being increased or decreased to reach indifference.

In this context it is not expected that the risk increase versus risk decrease distinction will be as consequential, as in studies of risk-dollar tradeoffs. Under the risk-risk approach, the respondent will always encounter risks, the only issue is what the risk mix will be. The likelihood of asymmetric and alarmist responses to risk increases consequently should not be a major factor. A potential advantage of the risk-risk approach in survey contexts is that it will reduce the biases induced by limitations on individual rationality.

The third question in Questionnaire A focuses on the more traditional risk-dollar trade-off involving CB and cost-of-living. Area A has the same cost of living as the respondent's present residence, but Area B has a cost of living that is $80 higher, yet poses a lower CB risk X. This CB risk is

Table 3

Comparison of Two CB - Auto Death Risk Trade-offs

Part	CB Risk	Auto Risk	Procedure	Trade-off
1.	$X_a > X_b$	$Y_b > Y_a$	Increase X_a until achieve indifference	$\frac{Y_b - Y_a}{X_a - X_b}$
2.	$X_b > X_a$	$Y_a > Y_b$	Reduce X_b until achieve indifference	$\frac{Y_a - Y_b}{X_b - X_a}$

increased until indifference is achieved. In the context of a state-dependent utility function with two arguments, health status and income, we have

$$X_aU(CB) + (1 - X_a)U(H) = X_bU(CB,-\$80) + (1-X_b)U(H,-\$80).$$

If utility functions are additively separable in money and health, then

$$X_aU(CB) + (1 - X_a)U(H) = X_bU(CB) + (1 - X_b)U(H) + U(-\$80),$$

which simplifies to

$$(X_a - X_b)U(CB) = U(-80) + (X_a - X_b)U(H),$$

or

$$U(CB) = \frac{U(-\$80)}{(X_a - X_b)} + U(H)$$

If we assume that utility is linear in money in establishing our health valuation scale, then we have

$$U(CB) = - L + U(H),$$

or CB is equivalent to being healthy and suffering a financial loss tantamount to

$$L = \frac{- 80}{X_a - X_b} .$$

The structure of Questionnaire B is similar except the certain $80 loss in terms of living costs has been replaced by a lottery on $2000 storm damage loss. In this case, respondents must specify the storm damage probability that establishes an equivalent CB-storm damage pair. If we assume that respondents are risk-neutral, then the storm damage loss can be replaced by its expected value. The possible advantage over the cost-of-living approach is that respondents may be able to make more meaningful comparisons of two different lotteries rather than having one attribute -- the dollar pay-off -- being non-stochastic. As in Parts 1 and 2 of Questionnaire A, the program leads the consumer to indifference by increasing the CB risk of the initially

preferred area until indifference is achieved. Part B-2 lowers the CB risk of the less preferred area until indifference is reached.

Questionnaire C repeats Parts 1 and 2 of Questionnaire A, and these samples will be pooled in the analysis below. Part C-3 addresses the more traditional death risk-dollar trade-off using auto deaths and cost of living trade-offs. The structure is similar to that of Questionnaire A-3 except that CB has been replaced by auto death risks so that respondents must reach the point where

$$U(D) = - L + U(H),$$

where

$$L = \frac{-80}{X_a - X_b}$$

as before. This portion of the study provides a direct comparability test with the literature on market-based values of life.

Sample Description

The interviews of the subjects were all done through an. interactive computer program, thus avoiding problems of interviewer bias and promoting honest revelation of preferences. Response rates to sensitive questions, such as income level, were much higher than with a face-to-face interview. In addition, subjects will not be concerned with whether their responses will impress the interviewer. Use of a computer also made it possible to ask a sequence of questions to ascertain the appropriate marginal rates of substitution.

The sample was recruited for the study by a professional marketing firm at a mall intercept in Greensboro, North Carolina. This locale has a representative household mix and is used as a test marketing site for many

national consumer brands. Use of such a consumer sample also will yield more reliable responses to issues such as the valuation of property damage from storms than would a student sample or a sample from a city with an unrepresentative population, such as the college-oriented cities of Evanston, Illinois or Chapel Hill, North Carolina.

Table 4 provides a glossary of the variables for future reference, and Table 5 summarizes the sample characteristics. Questionnaires A and C had a similar mix of respondents, with a mean age (AGE) in the low thirties, a 50-50 male (MALE) - female composition, two years of college education (EDUCATION), a 50 percent married rate (MARRIED), about 0.6 children under 8 years old (KIDS), a household size of 2.7 - 2.8 (HOUSEHOLD), and a household income (INCOME) in the mid-range of thirty to forty thousand. Questionnaire B has a somewhat different mix because of the difference in the times at which the samples were recruited (e.g., week-end shoppers differ from day-time weekday shoppers). The Questionnaire B sample is about 10 years older, more likely to be married, and with a household income about $10,000 greater.

The next series of variables provide background information on respondent activities and preferences. Most of the respondents have had a bad chest cold (COLD), but a minority comparable to the national average smoke (SMOKE). Most respondents rank the following consequences of CB high on the disutility scale: shortness of breath (BREATH), having one's back pounded as a CB treatment (POUNDED), and being hospitalized occasionally (HOSPITAL). Sample members on average exercise for three hours per week (EXERCISE), drive over 14,000 miles per year (MILES), and own their own home.

The final set of variables pertains to the valuation trade-offs, the

Table 4

Variable Definitions

Variable Label	Definition
AGE	Respondent age in years.
MALE	Male dummy variable (d.v.), equals 1 if respondent is male; 0 otherwise.
EDUCATION	Years of schooling.
MARRIED	Marital status d.v., equals 1 if respondent is married; 0 otherwise.
KIDS	Number of children under 8.
HOUSEHOLD	Number of people in respondent's household.
INCOME	Respondent's household income, in dollars.
COLD	Chest cold d.v., equals 1 if respondent has ever had a bad chest cold; 0 otherwise.
SMOKER	Smoker d.v., equals 1 if respondent smokes; 0 otherwise.
BREATH	Short breath disutility d.v., equals 1 if respondent's disutility of short breath is greater than 40 on a scale of 1 to 49; 0 otherwise.
POUNDED	Back pounded disutility d.v., equals 1 if respondent's disutility of having back pounded (a treatment for chronic bronchitis) is greater than 40 on a scale of 1 to 49; 0 otherwise.
HOSPITAL	Hospital disutility d.v., equals 1 if disutility of occasional hospitalization is greater than 40 on a scale from 1 to 49; 0 otherwise.
EXERCISE	Hours that the respondent exercises per week.
MILES	Miles driven by the respondent per year.
OWN HOME	Home ownership d.v., 1 if respondent owns his/her home; 0 otherwise.

Table 4 (cont'd)

Variable Definitions

Variable Label	Definition
CB-Auto	Auto death equivalent per chronic bronchitis case.
CB-Cost of Living	Dollar value per 1/100,000 reduced risk of bronchitis.
CB-Storm Damage	Probability of $2000 storm damage equivalent to one bronchitis case.
Auto-Cost of Living	Dollar value per 1/100,000 reduced risk of an auto accident.

Table 5

Summary of Sample Characteristics

	Means and Std. Deviations		
	Questionnaire		
Variable	A	B	C
AGE	33.74 (12.42)	43.47 (12.68)	33.07 (11.66)
MALE	0.50 (0.50)	0.42 (0.50)	0.51 (0.50)
EDUCATION	14.02 (2.23)	14.32 (2.47)	13.79 (2.66)
MARRIED	0.49 (0.50)	0.79 (0.41)	0.49 (0.50)
KIDS	0.56 (1.00)	0.83 (1.04)	0.65 (1.07)
HOUSEHOLD	2.71 (1.25)	3.00 (1.16)	2.80 (1.23)
INCOME	35,386.60 (19,009.95)	45,367.65 (20,335.54)	37,153.85 (21,333.80)
COLD	0.62 (0.49)	0.59 (0.49)	0.68 (0.47)
SMOKER	0.29 (0.45)	0.30 (0.46)	0.35 (0.48)
BREATH	0.76 (0.43)	0.76 (0.43)	0.79 (0.41)
POUNDED	0.77 (0.42)	0.76 (0.43)	0.84 (0.37)
HOSPITAL	0.83 (0.38)	0.85 (0.36)	0.90 (0.30)
EXERCISE	3.41 (2.75)	2.78 (2.46)	3.07 (2.52)

Table 5 (cont'd)

Summary of Sample Characteristics

	Means and Std. Deviations		
	Questionnaire		
Variable	A	B	C
MILES	14670.10 (7502.81)	-	14123.08 (7612.40)
OWN HOME	-	0.92 (0.27)	-
CB-Auto (A-1 & C-1)	0.65 (0.82)	-	0.70 (0.95)
CB-Auto (A-2 & C-2)	0.63 (0.79)	-	0.59 (0.72)
CB-Cost of Living (A-3)	8.83 (12.50)	-	-
Storm Damage (B-1)	-	852.60 (1064.20)	-
CB-Storm Damage (B-2)	-	707.02 (933.26)	-
Auto-Cost of Living (C-3)	-	-	81.84 (168.54)
Sample Size	194	204	195

units of which will be described below. As the last row of Table 4 indicates, each of the three samples had about 200 respondents so that our combined sample for the studies was 593.

3. Risk-Risk Trade-Offs

The first set of trade-offs to be analyzed is that between CB and auto accident deaths. For this analysis Questionnaires A-1 and C-1 are pooled, as are A-2 and C-2, since the questions are identical.

Establishing a death risk metric for CB enables respondents to think in risk terms, avoiding the comparability problems that might be encountered if monetary attributes were introduced. Similarly, for policy purposes EPA can establish a death risk equivalent and establish cost-effectiveness ratios in terms of the cost per statistical death prevented. As indicated in Viscusi (1986), this cost-effectiveness index will provide a comprehensive measure of the policy impact and also avoid the political sensitivities of placing dollar values on all health outcomes. Once a uniform health metric is established, one can then compare the cost per life equivalent saved with various value-of-life reference points and decide whether the policy should be pursued.

Unlike market-based studies of the value of life, the survey technique yields information on the entire distribution of the valuations. Table 6 reports the deciles of the distribution for respondents who gave consistent answers that converged to a particular tradeoff value. As we will discuss in Section 6, the requirement that the response pattern to the series of paired comparisons be internally consistent will lead to more meaningful estimates than if no such checks were imposed. These consistency checks distinguish our

Table 6

Distribution Chronic Bronchitis -

Auto Death Trade-Offs

Decile	Auto Death Equivalents per Chronic Bronchitis Case	
	Lower Base Bronchitis Risk (A-1 and C-1)	Higher Base Bronchitis Risk (A-2 and C-2)
.10	0.12	0.05
.20	0.20	0.15
.30	0.23	0.17
.40	0.27	0.17
.50 (median)	0.32	0.23
.60	0.40	0.40
.70	0.80	0.80
.80	1.00	1.00
.90	1.33	1.60
1.00	4.00	4.00
Mean	0.68	0.61
(std. error of mean)	(0.06)	(0.05)

approach from the usual contingent valuation method in which respondents' answers are taken at face value without such formal tests of whether the subjects understood the valuation task.

The interpretation of the results in Table 6 is as follows. Consider the A-1 and C-1 column. The respondent at the tenth percentile viewed a chronic bronchitis probability as being just as severe as a risk of an auto accident that was 0.12 as great. Thus, this individual would view a chronic bronchitis risk of 100/100,000 per year as being equivalent to the annual chance of being involved in an auto accident of 12/100,000.

Consider now the respondent at the top end of the distribution. This individual views a chronic bronchitis risk as being 4 times as severe as a risk of death, so that a 100/100,000 risk of CB would be viewed as comparable to a 400/100,000 risk of death.

The response pattern in which CB was more highly valued than auto death risks was exhibited by the top two deciles for each questionnaire's response distribution. Such a pattern is not necessarily implausible. Two explanations can be offered. First, individuals might legitimately believe that such a severe chronic illness is a worse outcome than death. Their normal activities would be curtailed, medical interventions including hospitalization and possible reliance on a portable oxygen tank would accompany severe cases of CB, other illnesses would be more likely, and they would experience periods of depression.

The second possible explanation is that the respondents were establishing equivalencies between different average risks in an area rather than different risks to themselves. The CB risk was characterized as an involuntary risk not

under their control except for smoking, whereas the auto accident risk differs depending on one's driving habits and skills. Other studies suggest that individuals may have overly optimistic assessments of risks influenced by their actions, such as auto death risks, as discussed in Viscusi and Magat (1987). If this were the case, the perceived person-specific risk would be below the stated risk, causing an upward bias in the results in Table 2.

Rather than eliminate the tails of the distribution, we show all of the responses in Table 6. The median CB valuation is equivalent to 0.32 auto deaths for A-1 and C-1 and 0.23 auto deaths for A-2 and C-2. Because of the skewed nature of the responses, the mean value is more than double the median response. For A-1 and C-1 the mean auto risk equivalent is 0.68 and for A-2 and for C-2 it is 0.61. These values differ from each other by just over one standard error, so that there are no statistically significant differences in the mean response values across the two survey approaches.

The similarity in the responses to Parts 1 and 2 of Questionnaires A and C can be explored further using the results in Table 7. Since the results are similar for Questionnaires A and C, we will focus the discussion on Questionnaire A. Respondents are roughly evenly distributed among the three categories of responses where the CB value in Part 1 is i) greater than, ii) equal to, or iii) less than the response in Part 2. The percentage of respondents who have a higher value on A-1 than A-2 is only 4 percent greater than the percentage who have a higher valuation on A-2 than A-1. Moreover, the 95% confidence intervals for the fractions overlap so that these differences are not statistically significant. Similarly, the magnitude of the gap between the Part 1 and Part 2 responses (see the first and third rows

Table 7

Summary of Response Differences

for Parts 1 and 2 of Questionnaire A and C

	Fraction (Std. Error of Mean)	Mean (Std. Error of Mean) Part 1 Value - Part 2 Value
CB Value (A-1) > CB Value (A-2)	0.446 (0.052)	0.576 (0.117)
CB Value (A-2) = CB Value (A-2)	0.141 (0.037)	0 (0)
CB Value A-1 < CB Value (A-2)	0.413 (0.052)	-0.697 (0.114)
CB Value (C-1) > CB Value (C-2)	0.477 (0.048)	0.662 (0.124)
CB Value (C-1) = CB Value (C-2)	0.128 (0.032)	0 (0)
CB Value (C-1) < CB Value (C-2)	0.394 (0.047)	-0.582 (0.115)

of the last column in Table 7), given that a discrepancy of a particular sign exists, is negligible and is well within the confidence limits for the mean value of the response differences.

The general implications of these results is as follows. The risk of chronic bronchitis is generally viewed as a less severe outcome than the risk of death, but not in all cases. The prospect of a sustained chronic illness is clearly viewed as a very severe outcome that is generally viewed as being below death in terms of its severity. Based on the median responses, the death risk equivalent of CB is 0.2 - 0.3, and based on the mean response it is 0.6 - 0.7. In each case the general order of magnitude is the same and is just below that of fatalities. As will be indicated in Section 5, these statistics can be transformed into dollar valuation equivalents using established value-of-life statistics.

4. Risk-Dollar Valuations of Chronic Bronchitis

The second approach that we employed to value chronic bronchitis was to establish risk-dollar trade-offs. The two approaches used were to establish the chronic bronchitis risk equivalent of a higher cost of living and to determine the relationship between chronic bronchitis risks and storm damage risks.

Consider first the cost-of-living results in Table 8. The first column of Table 8 lists the decile of the distribution. Column two presents the increased dollar value in the annual cost of living that the respondent was willing to incur per 1/100,000 reduction in the annual probability of chronic bronchitis. If we multiply the results in column 2 by 100,000 we obtain the

Table 9

Distribution of Chronic Bronchitis -

Storm Damage Trade-offs

	(B-1) Lower Base Chronic Bronchitis Risk		(B-2) Higher Base Chronic Bronchitis Risk	
Decile	Equivalent $2000 Damage Probability/ 100,000	Implicit Dollar Value per Case of Chronic Bronchitis	Equivalent $2000 Damage Probability/ 100,000	Implicit Dollar Value per Case of Chronic Bronchitis
.10	175.00	$350,000	60.00	$120,000
.20	228.57	$457,140	161.54	$323,080
.30	266.67	$533,340	186.67	$373,340
.40	266.67	$533,340	200.00	$400,000
.50 (median)	400.00	$800,000	266.67	$533,340
.60	533.33	$1,066,660	400.00	$800,000
.70	800.00	$1,600,000	800.00	$1,600,000
.80	1,333.33	$2,666,660	1,000.00	$2,000,000
.90	2,000.00	$4,000,000	2,000.00	$4,000,000
1.00	4,000.00	$8,000,000	4,000.00	$8,000,000
Mean	852.60	$1,705,200	707.02	$1,414,040
(std. error of mean)	(91.93)	($183,860)	(80.32)	($160,640)

implicit value per case of chronic bronchitis.

As in the case of the risk-risk results, the response pattern is skewed so that the upper tail of the responses generates a mean valuation estimate in excess of the median. The results here indicate the average dollar value of chronic bronchitis is $883,000, with an associated standard error of $114,000. The median of the distribution is just over half of the mean, as it is $457,000. Each of these values is below the usual estimates of the implicit value of life, which are reviewed in Viscusi (1986).

As in the case of the risk-risk tradeoffs, the upper bound of the CB valuation estimates exceeds the value of a fatality, as $8 million exceeds some but not all estimates of the value of life. More precise comparisons of all of the results using a dollar metric will be undertaken in Section 5.

The second set of CB risk-dollar tradeoffs, which is reported in Table 9, uses storm damage risks as the dollar counterpart so that respondents must equate monetary lotteries and health status lotteries. Questionnaire B-1 addressed this trade-off by raising the storm damage risk in the area with the lower base CB risk, whereas Questionnaire B-2 lowered the storm damage risk for the ones with the higher CB risk until indifference was achieved.

The first column of results for each of the questionnaire variants gives the value of y for which a storm causing damage of $2000 with a probability of y/100,000 is equivalent to a chronic bronchitis probability of 1/100,000. A more meaningful metric is the expected storm damage that is equivalent to each CB case. To obtain this figure one must multiply the first column of results by the $2000 damage per storm damage event. The second column of results for each questionnaire gives the dollar value per statistical case of

chronic bronchitis, where these dollar values have been obtained using the storm damage costs.

The relationship between the Questionnaire responses varies depending on the statistic one examines. The median CB value is $800,000 for Questionnaire B-1, which exceeds the $533,340 value for Questionnaire B-2. This relationship is reversed for the mean valuations, as the mean CB valuation in the B-1 case is $1,705,200, which exceeds the $1,414,040 result. The standard errors of the mean estimates are just over 10 percent of the mean values so that the 95% confidence intervals for the two mean estimates overlap.

5. Trade-Offs between Auto Deaths and Cost-of-Living

A useful check on the survey methodology is to ascertain the implicit value of life using a direct fatality risk-dollar tradeoff. This is done using automobile accident risks and cost of living in Questionnaire C-3, and the results of this exploration are reported in Table 10.

The median response of $2,286,000 is quite reasonable, but the mean value of $8,184,000 seems rather large. The high mean estimate was generated by a portion of the sample with value of life estimates as high as $80,000,000. Such implausibly large estimates can occur because of the difficulty of the comparison task. Respondents are being asked to establish an equivalence between some annual chance of chronic bronchitis X/100,000 that is equivalent to an $80 cost-of-living increase. This is a difficult comparison to make on a sensible basis. In contrast, the risk-risk questions focused on chronic bronchitis - auto accident risk comparisons of x/100,000 and y/100,000 where most respondents did not believe that the severity of outcomes differed by

Table 10

Distribution of Auto Accident -

Cost of Living Trade-Offs

(C-3)

Decile	Dollar Value per 1/100,000 Reduced Risk of Accident	Implicit Dollar Value of an Accident
.10	10.00	$1,000,000
.20	17.50	$1,750,000
.30	17.50	$1,750,000
.40	20.00	$2,000,000
.50 (median)	22.86	$2,286,000
.60	26.67	$2,667,000
.70	40.00	$4,000,000
.80	80.00	$8,000,000
.90	177.78	$17,778,000
1.00	800.00	$80,000,000
Mean	81.84	$8,184,000
(std. error of mean)	(14.40)	($1,440,000)

more than an order of magnitude.

The implicit dollar value of CB can be obtained by chaining the responses to questionnaire part C-1, which gives the CB-auto death tradeoff, and part C-3 which gives the auto death-dollars tradeoff. These results appear in Table 11. The median dollar value of each chronic bronchitis case is $800,000. The mean is much greater because there is one outlier who had a $320 million value. This individual hit extreme responses on each component part, valuing each CB case at 4 times the amount of each death and having an implicit value of an auto fatality of $80 million. In each case these were the highest values in the sample and the highest permitted by the program, which suggests that this individual did not understand the task.

An instructive summary of the results is provided in Table 12. For the results creating CB/Auto death risk equivalents, the numbers have been transformed into implicit value-of-life terms using three different reference points: a $2 million value of life, a $3 million value of life, and a $5 million value of life. The $2 million figure is comparable to the median auto death risk valuation within the survey so that this estimate provides an internal comparison of the results. The $3 million figure is included since the recent estimates by Moore and Viscusi (1988) indicate that the labor market value of life is in the $2-$3 million range using BLS data, and this was the "best estimate" of the value of life in earlier work by Viscusi (1983). The $5 million reference point is the value of life figure obtained using new NIOSH data on job fatality risks, which Moore and Viscusi (1988) view to be superior to the BLS data.

The pattern displayed by the results is fairly similar. In each case

Table 11

Implicit Valuation of Chronic Bronchitis

Implied by CB-Auto Death and Auto Death - Cost of Living Tradeoffs

Fractiles	Questionnaire C Inferred CB Value
.10	$200,000
.20	$350,000
.30	$522,449
.40	$646,154
.50	$800,000
.60	$1,066,667
.70	$2,133,333
.80	$3,555,556
.90	$12,800,000
.99	$71,111,111
1.00	$320,000,000
Mean	$6,962,364
(Std. Error of Mean)	($2,977,373)
	(N = 112)

Table 12

Summary of Risk-Dollar Equivalents

	Direct Valuation Estimate	CB Estimate Using $2 Million Value of Life	CB Dollar Estimate Using $3 Million Value of Life	CB Dollar Estimate Using $5 Million Value of Life
CB/Auto:				
A-1 & C-1 (Median)	--	$640,000	$960,000	$1,600,000
A-1 & C-1 (Mean)	--	$1,360,000	$2,040,000	$3,400,000
A-2 & C-2 (Median)	--	$460,000	$690,000	$1,150,000
A-2 & C-2 (Mean)	--	$1,220,000	$1,830,000	$3,050,000
CB/Cost of Living:				
A-3 (Median)	$457,000	--	--	--
A-3 (Mean)	$883,000	--	--	--
CB/Storm Damage:				
B-1 (Median)	$800,000	--	--	--
B-1 (Mean)	$1,705,200	--	--	--
B-2 (Median)	$533,340	--	--	--
B-2 (Mean)	$1,414,040	--	--	--
Auto/Cost of Living:				
C-3 (Median)	$2,286,000	--	--	
C-3 (Mean)	$8,184,000	--	--	

mean valuations are at least double the value of the median. Although one would not expect symmetry in a distribution truncated at zero, the very high end responses observed may be due to response errors.

The most clearcut divergence from plausible patterns is the mean value of life of $8,184,000 for the auto death/cost-of-living tradeoff. Whereas the mean CB/Auto values were roughly double the median, the mean Auto/Cost of Living values were almost four times the size of the median, indicating a much more skewed distribution. As noted in the discussion of Table 10, this mean value was influenced in part by individuals with implied values of life as high as $80 million. These outliers suggest that for some people making meaningful tradeoffs involving small cost-of-living differences and low risks of auto accident fatalities is a task they cannot handle effectively.

The valuation of chronic morbidity across the different questionnaire approaches is quite similar for the case in which we use a $2 million value of life figure to transform the death equivalent statistics into meaningful dollar estimates. The median values for the CB/Auto tradeoffs range from $460,000 - $640,000, as compared with a median value of $457,000 for the CB/Cost of Living tradeoff and a median value range of $533,340 - $800,000 for the CB/Storm Damage results. Even with a higher value of life of $3 million, the CB/Auto median range of $690,000 - $960,000 is not out of line with the CB/Cost of Living and CB/Storm Damage results.

Once we move to the case where a $5 million value of life is used, the dollar valuation of each CB case prevented is greatly increased to the $1,150,000 - $1,600,000 range. If EPA were to rely on, for example, the CB/Cost of Living results to value CB and then use a value of life of $5

million without also using an appropriately adjusted CB value, this procedure could potentially understate the value of the CB cases prevented by a factor of 35. By converting all outcomes to a health risk equivalence scale using a death risk metric, EPA avoids any distortion in the mix of illnesses that are addressed that might otherwise occur if the value of life number selected was incorrect.

6. Differences in Valid Response Rates

With a one-step contingent valuation (CV) study, the response rate is usually quite high. Thus, if we asked respondents how much of a price premium they would pay to reduce the poisoning risks for insecticide by a certain amount, almost all respondents give an answer within the realm of possibility. Although CV techniques generate a response, there are no internal consistency checks to ensure that the response truly reflects individual preferences.

With our interactive computer program, such consistency checks were incorporated directly. Individuals responding to paired comparison choices were first taken through an exercise to verify that they understood the task and could identify a dominant alternative. Their responses to the sequence of pairwise choices could then be analyzed to ensure that the preferences adhered to consistency standards. In particular, the sample we analyzed excluded individuals in the following categories:

(1) individuals whose responses failed to converge to a tradeoff rate,

(2) individuals who preferred a dominated alternative,

(3) individuals who were indifferent to all alternatives,

(4) individuals who exhibited inconsistent preferences, and

(5) individuals whose trade-off value was zero.

There were a number of variations on these departures from rationality that we determined based on a detailed analysis of the response sequence.

Table 13 provides probit equation estimates of the probability of giving a valid response. As the bottom row of the table indicates, the response probabilities ranged from 0.624 to 0.703 so that in all cases about two-thirds of the sample gave consistent responses. The lowest valid response rate was for the CB/Cost of Living tradeoff (A-3), and the highest response rate was for the Auto Death/Cost of Living questions.

Few of the fourteen explanatory variables used in estimating the valid response probability equation were significant. Those that were consequential followed plausible patterns. First, older respondents had difficulty with two of the questionnaire variants (A-1 & C-1 and B-1). The difficulty of the task and perhaps the use of a new interview technology (computers) may have affected the older respondents' performance. However, in four of the six cases there were no statistically significant age effects. The second systematic pattern is that smokers are better able to answer both of the CB/Auto Death Risk Tradeoff questionnaires (A-1 & C-1 and A-2 & C-2), which probably reflects the greater thought that they have given to the implications of chronic bronchitis for their lives. The remaining variables capturing preference intensity or risk-related personal characteristics were not consequential.

A potentially important determinant of the likelihood of a valid response to any question sequence is the degree to which the subject has mastered the interview task. A useful proxy for such understanding is the relationship

Table 13

Probit Estimates for the Probability
of a Valid Trade-Off Response

Independent Variable	Coefficients (Asymptotic Std. Errors) A-1 and C-1	A-2 and C-2	A-3	B-1	B-2	c-3
MALE	0.119 (0.142)	0.209 (0.143)	0.054 (0.199)	0.331 (0.196)	0.122 (0.193)	-0.151 (0.216)
MARRIED	0.210 (0.161)	-0.174 (0.160)	-0.149 (0.215)	-0.206 (0.254)	-0.135 (0.251)	0.264 (0.253)
KIDS	-0.031 (0.069)	-0.034 (0.069)	-0.057 (0.102)	-0.026 (0.098)	-0.071 (0.098)	0.005 (0.101)
EDUCATION	0.036 (0.029)	-0.028 (0.029)	0.023 (0.046)	-0.037 (0.041)	-0.033 (0.042)	-0.006 (0.040)
INCOME	0.38E-5 (0.35E-5)	0.50E-5 (0.35E-5)	0.27E-5 (0.53E-5)	0.33E-5 (0.49E-5)	-0.50E-5 (0.48E-5)	-0.60E-5 (0.48E-5)
AGE	-0.017 (0.006)	-0.005 (0.006)	-0.003 (0.008)	-0.022 (0.009)	-0.011 (0.009)	-0.014 (0.010)
COLD	0.122 (0.144)	-0.019) (0.144)	0.103 (0.203)	-0.177 (0.203)	-0.015 (0.200)	0.112 (0.222)
SMOKER	0.353 (0.153)	0.297 (0.153)	-0.382 (0.211)	-0.164 (0.220)	0.152 (0.221)	0.320 (0.226)
BREATH	0.134 (0.189)	0.239 (0.187)	0.132 (0.262)	0.402 (0.257)	0.046 (0.262)	0.417 (0.291)
POUNDED	-0.258 (0.238)	-0.369 (0.238)	-0.427 (0.350)	0.052 (0.286)	0.292 (0.283)	-0.515 (0.366)
HOSPITAL	0.235 (0.290)	0.334 (0.292)	0.329 (0.422)	-0.253 (0.332)	-0.093 (0.332)	0.308 (0.440)
EXERCISE	0.014 (0.027)	-0.027 (0.027)	0.045 (0.037)	-0.025 (0.040)	0.016 (0.039)	-0.018 (0.042)
MILES	0.75E-5 (0.97E-5)	-0.50E-5 (0.98E-5)	-0.19E-4 (0.14E-4)	- -	- -	0.33E-5 (0.l4E-4)

Table 13 (cont'd)

Probit Estimates for the Probability
of a Valid Trade-Off Response

Independent Variable	Coefficients (Asymptotic Std. Errors) A-1 and C-1	A-2 and C-2	A-3	B-1	B-2	C-3
OWN HOME	-	-	-	-0.129	0.202	-
	-	-	-	(0.390)	(0.370)	-
Mean Valid Response Probability	0.645	0.658	0.624	0.657	0.662	0.703

among questionnaires in the valid response rate. Whereas the valid response rate to A-1 and C-1 was .645 (from Table 13), in Table 14 these valid response rates range from .719 - .852 for individuals who had valid responses to other parts of the questionnaire. A similar pattern is displayed by the other questions as well, as individuals who had valid responses elsewhere were 10-20 percent more likely to give valid responses for any given segment of the questionnaire.

Overall, it appears that about one-third of the respondents were not consistent. Since valid responses on other parts of the survey diminish the invalid response rate by about half, the inconsistency in choices appears to be roughly equally attributable to not being able to handle the survey task in a consistent fashion and random factors.

7. Factors Affecting the Trade-Offs

The main factor influencing the expressed risk-risk trade-off appears to be the revealed trade-off from other parts of the questionnaire. Tables 15 and 16 present an illustrative set of regression results. Table 16 differs in that no tradeoff result from another section of the questionnaire is included. As can be seen, the tradeoff on A-2 & C-2 had a strong positive effect on the A-1 & C-1 response, and similarly the A-1 & C-1 values had a powerful effect on A-2 & C-2.

With the exception of two positive EDUCATION coefficients, none of the other variables are statistically significant. Smokers and non-smokers did not differ in their tradeoff rates, and variables such as INCOME were inconsequential. The absence of substantial demographic variations is neither

Table 14

Differences in Valid Response Levels by Questionnaire

Questionnaire A:

Group with Valid Responses	Fraction with Valid Responses on A-1	Fraction with Valid Responses on A-2	Fraction with Valid Responses on A-3
Valid Response on A-1	1.000	0.767	0.733
Valid Response on A-2	0.719	1.000	0.688
Valid Response on A-3	0.727	0.727	1.000

Questionnaire B:

Group with Valid Responses	Fraction with Valid Responses on B-1	Fraction with Valid Responses on B-2
Valid Response on B-1	1.000	0.769
Valid Response on B-2	0.763	1.000

Questionnaire C:

Group with Valid Responses	Fraction with Valid Responses on C-1	Fraction with Valid Responses on C-2	Fraction with Valid Responses on C-3
Valid Response on C-1	1.000	0.832	0.763
Valid Response on C-2	0.852	1.000	0.750
Valid Response on C-3	0.730	0.701	1.000

Table 15

Analysis of Factors Affecting Trade-Offs

Independent Variables	Ln Trade-Off CB - Auto A-1 and C-1	Ln Trade-Off CB - Auto A-2 and C-2	Ln Trade-Off CB - Cost of Living A-3
MALE	0.040 (0.143)	-0.229 (0.158)	-0.268 (0.365)
MARRIED	0.032 (0.180)	-0.165 (0.200)	0.704 (0.449)
KIDS	-0.117 (0.098)	0.024 (0.110)	-0.051 (0.275)
HOUSEHOLD	0.090 (0.084)	-0.050 (0.093)	-0.297 (0.227)
EDUCATION	0.064 (0.032)	-0.019 (0.036)	0.174 (0.088)
INCOME	-4.2E-6 (3.7E-6)	-1.1E-6 (4.2E-6)	1.8E-5 (1.0E-5)
AGE	0.010 (0.008)	0.004 (0.009)	0.019 (0.019)
SMOKER	0.087 (0.148)	0.093 (0.165)	-0.227 (0.449)
Ln Trade-Off CB-Auto on other part of questionnaire	0.295 (0.061)	0.365 (0.076)	0.248[a] (1.185)
$\bar{R}^2$	.14	.13	0.09

[a]This coefficient is for the variable that represents the average of the respondent's answers to Parts A-1 and A-2 of the questionnaire.

Table 16

Analysis of Factors Affecting Trade-Offs

Independent Variables	Ln Trade-Off CB - Auto A-1 and C-1	Ln Trade-Off CB - Auto A-2 and C-2	Ln Trade-Off CB - Cost of Living A-3
MALE	-0.089 (0.137)	-0.136 (0.244)	-0.273 (0.168)
MARRIED	-0.082 (0.169)	0.053 (0.285)	-0.406 (0.200)
KIDS	-0.044 (0.094)	0.060 (0.191)	0.087 (0.115)
HOUSEHOLD	0.036 (0.079)	-0.155 (0.139)	-0.065 (0.098)
EDUCATION	0.035 (0.030)	0.097 (0.060)	0.003 (0.037)
INCOME	-6.3E-6 (3.7E-6)	-9.2E-6 (6.3E-6)	1.3E-6 (4.2E-6)
AGE	0.007 (0.007)	0.013 (0.011)	0.002 (0.008)
SMOKER	0.144 (0.146)	-0.124 (0.291)	0.036 (0.177)
$\bar{R}^2$	0.00	0.00	0.01

inconsequential. The absence of substantial demographic variations is neither surprising nor disturbing. Most individual attributes, such as household income, should affect the CB valuation and the value of life similarly. For the risk-risk tradeoffs, it is only factors that have a differential effect on these valuations that will be consequential in the regression equation.

8. Conclusion

With all of the methodologies we adopted, we obtained internally consistent valuations of chronic bronchitis outcomes. Our preference is for the risk-risk approach for several reasons. First, a comparison of health risks of comparable magnitude (e.g., 10/100,000 CB risk and 1/100,000 fatality risk) is a task that appears easier to give meaningful responses to than comparing a 1/100,000 CB risk with an $80 cost-of-living increase. Second, the results establish a death risk metric for EPA policy that limits the use of dollar values to the valuation of death risk equivalents. Such a procedure may not only be more potentially viable than attaching a dollar value to each outcome, but it may be a more sensible economic approach as well. In particular, when one performs a sensitivity analysis that reflected the range in the estimates of the value of life, the relationship among the values of different health outcomes will be preserved.

It should also be stressed that obtaining meaningful valuation responses is a nontrivial task. Substantial education of individuals regarding the health effects is required, and care must be taken to ensure that responses are consistent. One methodological approach that we believe would be invalid would be to elicit a large number of valuation estimates with a questionnaire

that did not make clear to the respondents the implication of different health outcomes for their well-being.

What our approach accomplishes is to establish economically meaningful measures of the valuation of risk attributes that cannot be estimated using available market risk data.

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Appendix

We include as an appendix a copy of the Questionnaire A. A set of the full Questionnaires A-C is available from the authors. Dr. Alan Carlin at EPA also has one copy.

Appendix: Questionnaire A

Question Number 1

Hello....

My name is Sam.

I am a computer who has been taught to ask people questions.

I will ask you some questions about areas in which you might live.

But first, type in your first name on the keyboard.

THEN PRESS ENTER...

Question Number 2

Thank you. ****

There are no right or wrong answers.

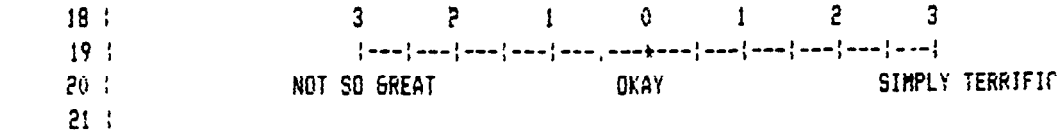
Please try to give us your honest opinion-- YOUR OPINIONS COUNT.

Of course your answers will be strictly confidential.

The questions I will ask can be answered by pressing the keys below

or by using the arrow keys the interviewer showed you on the keyboard

HOW DO YOU FEEL TODAY?



MOVE THE CURSOR WITH THE ARROW KEYS...THEN PRESS ENTER...
(you may ALWAYS put the cursor anywhere along the line)

Question Number 3

If you make a mistake, don't worry.

You can go back to an earlier question **by simply** pressing "X".

Would you like to see the last screen again? If you would

PRESS 'X'. otherwise....

PRESS ANY KEY....

Question Number 4

I AM A PRETTY SMART COMPUTER

BUT SOMETIMES I HAVE TROUBLE WITH SEX

PLEASE TELL ME IF YOU ARE:

1 FEMALE

2 MALE

PRESS THE NUMBER OF YOUR ANSWER...

Question Number 5

HOW MANY PEOPLE LIVE IN YOUR HOME,

INCLUDE YOURSELF AS WELL AS OTHER ADULTS AND CHILDREN?

1 1 PERSON

2 2 PEOPLE

3 3 PEOPLE

4 4 PEOPLE

5 5 OR MORE PEOPLE

PRESS THE NUMBER OF YOUR ANSWER...

Question Number 6

HOW MANY CHILDREN UNDER 18 YEARS OLD LIVE IN YOUR HOME?

1 1 CHILD

2 2 CHILDREN

3 3 CHILDREN

4 4 CHILDREN

5 5 CHILDREN

6 6 CHILDREN

7 7 OR MORE CHILDREN

8 NONE

PRESS THE NUMBER OF YOUR ANSWER...

Question Number 7

Thank you,

I am now going to ask how you feel about different areas where you could live.

Where you live affects:

* YOUR chance of getting CHRONIC BRONCHITIS from air pollution

* YOUR chance of a FATAL AUTOMOBILE ACCIDENT

and

* YOUR cost of living.

How you feel about these factors is important so that your government can make laws and regulations that reflect what you want.

PRESS ANY KEY...

Question Number 8

Because I am going to ask you questions about CHRONIC BRONCHITIS, I need to tell you a little bit about what it would mean for you to get this disease.

PRESS ANY KEY...

Question Number 9

The interviewer told you about CHRONIC BRONCHITIS.

DOES ANYONE YOU KNOW HAVE CHRONIC BRONCHITIS?

1 YES

2 NO

3 NOT SURE

PRESS THE NUMBER OF YOUR ANSWER. . .

Question Number 10

There are several lung diseases related to CHRONIC BRONCHITIS,

such as:

ASTHMA

EMPHYSEMA

BRONCHIOLITIS

DOES ANYONE YOU KNOW HAVE ANY OF THESE DISEASES?

1 YES

2 NO

3 NOT SURE

PRESS THE NUMBER OF YOUR ANSWER...

Question Number 11

If you developed CHRONIC BRONCHITIS, you would have it for the rest of your life, although it would not significantly decrease the number of years you live.

BEFORE TAKING THIS SURVEY, DID YOU KNOW THAT CHRONIC BRONCHITIS HAS NO EFFECT ON THE LENGTH OF YOUR LIFE?

1 YES

2 NO

PRESS THE NUMBER OF YOUR ANSWER...

Question Number 12

The chances of getting CHRONIC BRONCHITIS increase with age.

I AM JUST TWO YEARS OLD.

HOW OLD ARE YOU?

TYPE IN YOUR AGE ON THE KEYBOARD, THEN PRESS ENTER...

Question Number 14

With CHRONIC BRONCHITIS, you would feel an uncomfortable shortness of breath, much like having a bad chest cold that never goes away.

HAVE YOU EVER HAD A CHEST COLD THAT IS SO BAD THAT YOU HAD DIFFICULTY BREATHING?

1 NEVER

2 A FEW TIMES

3 OFTEN

PRESS THE NUMBER OF THE ANSWER.. .

Question Number 15

If you developed CHRONIC BRONCHITIS and were working outside your home, you would continue to work but would not be able to do those parts of your job involving active physical effort However, because of insurance, Social Security and other government programs, your medical bills and your wages would be covered.

ARE YOU CURRENTLY WORKING OUTSIDE YOUR HOME FOR PAY?

1 YES

2 NO

PRESS THE NUMBER OF YOUR ANSWER...

Question Number 1

If you had CHRONIC BRONCHITIS, you would have to frequently visit your doctor, regularly take medication, and periodically go to the hospital for more intensive medical care.

If you smoke, you would be urged to quit because smoking would worsen your breathing.

DO YOU SMOKE TOBACCO?

1 YES

2 NO

PRESS THE NUMBER OF YOUR ANSWER...

Question Number 1

DID YOU SMOKE CIGARETTES EARLIER IN YOUR LIFE?

1 YES

2 NO

PRESS THE NUMBER OF YOUR ANSWER...

Question Number 17

HOW LONG AGO DID YOU QUIT SMOKING CIGARETTES?

1 LESS THAN 1 YEAR

2 1-9 YEARS

3 10-19 YEARS

4 20-29 YEARS

5 30-39 YEARS

6 40-49 YEARS

7 50 YEARS OR LONGER

PRESS THE NUMBER OF YOUR ANSWER...

Question Number 18

WHEN YOU SMOKED, HOW MANY PACKS OF CIGARETTES DID YOU SMOKE PER DAY?

1 LESS THAN 1 PACK

2 1-2 PACKS

3 OVER 2 PACKS

PRESS THE NUMBER OF YOUR ANSWER...

Question Number 21

WHAT TYPE OF TOBACCO DO YOU SMOKE?

1 CIGARETTES ONLY

2 PIPES OR CIGARS, BUT NOT CIGARETTES

3 CIGARETTES, AND PIPES OR CIGARS

PRESS THE NUMBER OF YOUR ANSWER...

Question Number 22

ABOUT HOW MANY YEARS HAVE YOU BEEN SMOKING?

1 LESS THAN 1 YEAR

2 1-10 YEARS

3 10-20 YEARS

4 20-30 YEARS

5 30-40 YEARS

6 40-50 YEARS

7 OVER 50 YEARS

PRESS THE NUMBER OF YOUR ANSWER...

Question Number 23

ABOUT HOW MANY PACKS OF CIGARETTES DO YOU SMOKE PER DAY?

1 LESS THAN 1 PACK

2 1-2 PACKS

3 OVER 2 PACKS

PRESS THE NUMBER OF YOUR ANSWER...

Question Number 24

I need to know how strongly you feel about the different effects of CHRONIC BRONCHITIS with respect to the following:

-- LIVING WITH AN UNCOMFORTABLE SHORTNESS OF BREATH FOR THE REST OF YOUR LIFE
-- BEING EASILY WINDED FROM CLIMBING STAIRS
-- COUGHING AND WHEEZING REGULARLY
-- SUFFERING MORE FREQUENT DEEP CHEST INFECTIONS AND PNEUMONIA
-- HAVING TO LIMIT YOUR RECREATIONAL ACTIVITIES TO ACTIVITIES SUCH AS GOLF, CARDS, AND READING
-- EXPERIENCING PERIODS OF DEPRESSION
-- BEING UNABLE TO DO THE ACTIVE, PHYSICAL PARTS OF YOUR JOB
-- BEING LIMITED TO A RESTRICTED DIET
-- HAVING TO VISIT YOUR DOCTOR REGULARLY AND TO TAKE SEVERAL MEDICATIONS
-- HAVING TO HAVE YOUR BACK MILDLY POUNDED TO HELP REMOVE FLUIDS BUILT UP IN YOUR LUNGS
-- HAVING TO BE PERIODICALLY HOSPITALIZED
-- HAVING TO QUIT SMOKING
-- HAVING TO WEAR A SMALL, PORTABLE OXYGEN TANK

PRESS ANY KEY

Question Number 25

PLEASE RATE THE FOLLOWING EFFECTS OF CHRONIC BRONCHITIS

ON AN IMPORTANCE SCALE RANGING FROM NOT AT ALL IMPORTANT

TO AVOID TO EXTREMELY IMPORTANT TO AVOID.

-- LIVING WITH AN UNCOMFORTABLE SHORTNESS OF BREATH FOR
FOR THE REST OF YOUR LIFE

```
    3     2     1     0     1     2     3
    |---|---|---|---|---*---|---|---|---|---|
NOT AT ALL            SLIGHTLY            EXTREMELY
IMPORTANT             IMPORTANT           IMPORTANT
TO AVOID              TO AVOID            TO AVOID
```

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER...

Question Number 26

PLEASE RATE HOW STRONGLY YOU FEEL ABOUT AVOIDING THE FOLLOWING:

-- BEING EASILY WINDED FROM CLIMBING STAIRS

```
    3     2     1     0     1     2     3
    |---|---|---|---|---*---|---|---|---|---|
NOT AT ALL            SLIGHTLY            EXTREMELY
IMPORTANT             IMPORTANT           IMPORTANT
TO AVOID              TO AVOID            TO AVOID
```

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER...

Question Number 27

PLEASE RATE HOW STRONGLY YOU FEEL ABOUT AVOIDING THE FOLLOWING:

-- COUGHING AND WHEEZING REGULARLY

3	2	1	0	1	2	3
NOT AT ALL IMPORTANT TO AVOID			SLIGHTLY IMPORTANT TO AVOID			EXTREMELY IMPORTANT TO AVOID

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER...

Question Number 28

PLEASE RATE HOW STRONGLY YOU FEEL ABOUT AVOIDING THE FOLLOWING:

-- SUFFERING MORE FREQUENT DEEP CHEST INFECTIONS AND PNEUMONIA

3	2	1	0	1	2	3
NOT AT ALL IMPORTANT TO AVOID			SLIGHTLY IMPORTANT TO AVOID			EXTREMELY IMPORTANT TO AVOID

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER...

Question Number 29

PLEASE RATE HOW STRONGLY YOU FEEL ABOUT AVOIDING THE FOLLOWING:

-- HAVING TO LIMIT YOUR RECREATIONAL ACTIVITIES TO ACTIVITIES SUCH AS GOLF, CARDS, AND READING

3 2 1 0 1 2 3

NOT AT ALL IMPORTANT TO AVOID

SLIGHTLY IMPORTANT TO AVOID

EXTREMELY IMPORTANT TO AVOID

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER...

Question Number 30

PLEASE RATE HOW STRONGLY YOU FEEL ABOUT AVOIDING THE FOLLOWING:

-- EXPERIENCING PERIODS OF DEPRESSION

3 2 1 0 1 2 3

NOT AT ALL IMPORTANT TO AVOID

SLIGHTLY IMPORTANT TO AVOID

EXTREMELY IMPORTANT TO AVOID

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER...

Question Number 31

PLEASE RATE HOW STRONGLY YOU FEEL ABOUT AVOIDING THE FOLLOWING:

-- BEING UNABLE TO DO THE ACTIVE, PHYSICAL PARTS OF YOUR JOB

3	2	1	0	1	2	3
NOT AT ALL IMPORTANT TO AVOID			SLIGHTLY IMPORTANT TO AVOID			EXTREMELY IMPORTANT TO AVOID

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER...

Question Number 32

PLEASE RATE HOW STRONGLY YOU FEEL ABOUT AVOIDING THE FOLLOWING:

-- BEING LIMITED TO A RESTRICTED DIET

3	2	1	0	1	2	3
NOT AT ALL IMPORTANT TO AVOID			SLIGHTLY IMPORTANT TO AVOID			EXTREMELY IMPORTANT TO AVOID

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER...

Question Number 33

PLEASE RATE HOW STRONGLY YOU FEEL ABOUT AVOIDING THE FOLLOWING:

-- HAVING TO VISIT YOUR DOCTOR REGULARLY AND TO TAKE SEVERAL MEDICATIONS

3 2 1 0 1 2 3

NOT AT ALL IMPORTANT TO AVOID

SLIGHTLY IMPORTANT TO AVOID

EXTREMELY IMPORTANT TO AVOID

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER...

Question Number 34

PLEASE RATE HOW STRONGLY YOU FEEL ABOUT AVOIDING THE FOLLOWING:

-- HAVING TO HAVE YOUR BACK MILDLY POUNDED TO HELP REMOVE FLUIDS BUILT UP IN YOUR LUNGS

3 2 1 0 1 2 3

NOT AT ALL IMPORTANT TO AVOID

SLIGHTLY IMPORTANT TO AVOID

EXTREMELY IMPORTANT TO AVOID

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER...

Question Number 35

PLEASE RATE HOW STRONGLY YOU FEEL ABOUT AVOIDING THE FOLLOWING:

-- HAVING TO BE PERIODICALLY HOSPITALIZED

3	2	1	0	1	2	3
NOT AT ALL IMPORTANT TO AVOID			SLIGHTLY IMPORTANT TO AVOID			EXTREMELY IMPORTANT TO AVOID

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER...

Question Number 36

PLEASE RATE HOW STRONGLY YOU FEEL ABOUT AVOIDING THE FOLLOWING:

-- HAVING TO QUIT SMOKING

3	2	1	0	1	2	3
NOT AT ALL IMPORTANT TO AVOID			SLIGHTLY IMPORTANT TO AVOID			EXTREMELY IMPORTANT TO AVOID

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER...

Question Number 37

PLEASE RATE HOW STRONGLY YOU FEEL ABOUT AVOIDING THE FOLLOWING:

-- HAVING TO WEAR A SMALL, PORTABLE OXYGEN TANK

```
     3      2      1      0      1      2      3
     |---|---|---|---|---*---|---|---|---|---|---|
NOT AT ALL              SLIGHTLY              EXTREMELY
IMPORTANT               IMPORTANT             IMPORTANT
TO AVOID                TO AVOID              TO AVOID
```

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER...

Question Number 38

HOW MANY HOURS PER WEEK DO YOU ENGAGE IN STRENUOUS PHYSICAL EXERCISE,

SUCH AS JOGGING, TENNIS, AND COMPETITIVE SPORTS?

1 LESS THAN ONE

2 ONE- TWO

3 TWO- THREE

4 THREE- FOUR

5 FOUR- FIVE

6 FIVE- SIX

7 SIX- SEVEN

8 MORE THAN SEVEN

PRESS NUMBER OF YOUR ANSWER...

Question Number 39

COMPARED TO FRIENDS OF YOUR AGE, WOULD YOU CONSIDER YOURSELF...

1 MUCH LESS ACTIVE

2 SOMEWHAT LESS ACTIVE

3 ABOUT AS ACTIVE

4 SOMEWHAT MORE ACTIVE

5 MUCH MORE ACTIVE

PRESS THE NUMBER OF YOUR ANSWER...

Question Number 40

By living in different areas, you would face different chances of developing CHRONIC BRONCHITIS. You would also face different chances of having a FATAL AUTO ACCIDENT.

Now let me ask you some questions about your experience with FATAL AUTOMOBILE ACCIDENTS and with driving.

PRESS ANY KEY TO CONTINUE...

Question Number 41

HAVE YOU EVER LOST A CLOSE RELATIVE OR FRIEND

IN AN AUTOMOBILE ACCIDENT?

1 YES

2 NO

PRESS NUMBER OF YOUR ANSWER...

Question Number 42

YOUR chance of being in a fatal automobile accident depends on how many miles per year YOU travel.

The average North Carolina citizen travels approximately 10,000 miles per year (200 MILES PER WEEK), either as a passenger or the driver of a car.

PLEASE ESTIMATE THE NUMBER OF MILES YOU TRAVEL AS A

PASSENGER AND A DRIVER EACH YEAR?

1 UNDER 1,000 MILES PER YEAR

2 1,000-4,999 MILES PER YEAR

3 5,000-9,999 MILES PER YEAR

4 10,000-14,999 MILES PER YEAR

5 15,000-20,000 MILES PER YEAR

6 OVER 20,000 MILES PER YEAR

Question Number 43

WHEN YOU ARE IN A CAR, ARE YOU GENERALLY THE DRIVER OR THE PASSENGER?

1 ALMOST ALWAYS THE DRIVER

2 GENERALLY THE DRIVER

3 ABOUT HALF AND HALF

4 GENERALLY THE PASSENGER

5 ALMOST ALWAYS THE PASSENGER

PRESS NUMBER OF YOUR ANSWER...

Question Number 44

Now I am going to tell you about YOUR chance of

developing CHRONIC BRONCHITIS and YOUR chance of

DYING IN AN AUTO ACCIDENT...

I estimate YOUR chance of CHRONIC BRONCHITIS as follows:

IN ANY YEAR, YOU HAVE 100 CHANCES OUT OF 100,000

OF DEVELOPING CHRONIC BRONCHITIS.

Said another way, OUT OF A GROUP OF 100,000 PEOPLE LIKE YOU,

100 WILL DEVELOP CHRONIC BRONCHITIS EVERY YEAR.

PRESS ANY KEY...

Question Number 45

Furthermore, I estimate YOUR chance of DYING IN AN AUTOMOBILE ACCIDENT as follows:

IN ANY YEAR, YOU HAVE 20 CHANCES OUT OF 100,000 OF DYING IN AN AUTOMOBILE ACCIDENT.

Said another way, OUT OF A GROUP OF 100,000 PEOPLE LIKE YOU, 20 WILL DIE IN AN AUTOMOBILE ACCIDENT.

PRESS ANY KEY...

Question Number 46

Of course, everyone wants to live in a healthier and safer place.

To find out how much you value improvement in health and safety, I will ask you to evaluate areas that are HEALTHIER AND SAFER than where you live now.

In choosing among areas, consider only the risks of CHRONIC BRONCHITIS and FATAL AUTOMOBILE ACCIDENTS to YOURSELF and YOUR IMMEDIATE FAMILY.

PRESS ANY KEY...

Question Number 47

I ASK YOU TO ASSUME THAT THE NEW PLACES ARE

IDENTICAL IN ALL RESPECTS TO WHERE YOU PRESENTLY

LIVE EXCEPT:

-- you have a LOWER chance of DYING IN AN AUTO ACCIDENT

-- you have a LOWER chance of getting CHRONIC BRONCHITIS

PRESS ANY KEY.. .

Question Number 49

Remember that CURRENTLY
-- YOUR chance of CHRONIC BRONCHITIS is 100 out of 100,000 every year
-- YOUR chance of an AUTO DEATH IS 20 out of 100,000 every year

WHICH AREA DO YOU PREFER?

YOUR CHANCE	in AREA A	in AREA B
OF CHRONIC BRONCHITIS	75 out of 100,000	55 out of 100,000
OF DYING IN AN AUTO ACCIDENT	15 out of 100,000	11 out of 100,000

Let's be sure you understand the question. In Area A, YOUR chance of developing CHRONIC BRONCHITIS would be reduced to 75 out of 100,000. In Area B, YOUR chance of CHRONIC BRONCHITIS would be further reduced to 55 out of 100,000. Similarly your chance of a FATAL AUTO ACCIDENT is lower in both areas.

1 AREA A

2 AREA B

Question Number 50

WELL DONE, ****

You were right to prefer AREA B since it is better on

both CHRONIC BRONCHITIS AND AUTO DEATHS.

PRESS ANY KEY...

Question Number 51

Area B would be better on both CHRONIC BRONCHITIS and AUTO DEATH.
Since you may not have understood this, I would like you to
answer the question again.

WHICH AREA DO YOU PREFER?

YOUR CHANCE	in AREA A	in AREA B
OF CHRONIC BRONCHITIS	75 out of 100,000	55 out of 100,000
OF DYING IN AN AUTO ACCIDENT	15 OUT OF 100,000	11 out of 100,000

Let's be sure you understand the question. In Area A, YOUR chance
of developing CHRONIC BRONCHITIS would be reduced to 75 out of
100,000. In Area B, YOUR chances of CHRONIC BRONCHITIS would
be further reduced to 55 out of 100,000. Similarly
your chance of a FATAL AUTO ACCIDENT is lower in both areas.

1 AREA A

2 AREA B

NOW, PRESS THE NUMBER OF YOUR ANSWER

Question Number 53

You preferred Area B.

Now I will ask you BY HOW MUCH do you prefer Area B.

WHICH AREA DO YOU PREFER?

YOUR CHANCE	in AREA A	in AREA B
OF CHRONIC BRONCHITIS	75 out of 100,000	55 out of 100,000
OF DYING IN AN AUTO ACCIDENT	15 out of 100,000	11 out of 100,000

AREA A AREA B

3 2 1 0 1 2 3

Strongly prefer — About the same — Strongly prefer

MOVE CURSOR WITH ARROW KEYS... THEN PRESS ENTER...

Question Number 54

Since you preferred Area B please move the cursor along the

number line indicating BY HOW MUCH You preferred Area B.

WHICH AREA DO YOU PREFER?

YOUR CHANCE	in AREA A	in AREA B
OF CHRONIC BRONCHITIS	75 out of 100,000	55 out of 100,000
OF DYING IN AN AUTO ACCIDENT	15 out of 100,000	11 out of 100,000

AREA A AREA B

3 2 1 0 1 2 3

Strongly prefer — About the same — Strongly prefer

MOVE CURSOR WITH ARROW KEYS... THEN PRESS ENTER...

Question Number 55

GOOD WORK, now you have the hang of it !!

The rest of the questions will be somewhat harder to answer because AREA B will be better than AREA A on CHRONIC BRONCHITIS, but worse on AUTO DEATH.

PRESS ANY KEY.. . .

Question Number 56

Remember that CURRENTLY
-- YOUR chance of CHRONIC BRONCHITIS is 100 out of 100,000 every year
-- YOUR chance of an AUTO DEATH is 20 out of 100.000 every year

WHICH AREA DO YOU PREFER?

YOUR CHANCE	AREA A	AREA B
OF CHRONIC BRONCHITIS	75 out of 100,000	55 out of 100,000
OF DYING IN AN AUTO ACCIDENT	15 out of 100,000	19 out of 100,000

AREA A AREA B

3 2 1 0 1 2 3

Strongly prefer — About the same — Strongly prefer

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER OR X TO REDO...

Question Number 58

Remember that CURRENTLY
-- YOUR chance of CHRONIC BRONCHITIS is 100 out of 100,000 every year
-- YOUR chance of an AUTO DEATH is 20 out of 100,000 every year

WHICH AREA DO YOU PREFER?

YOUR CHANCE	AREA A	AREA B
OF CHRONIC BRONCHITIS	75 out of 100,000	55 out of 100.000
OF DYING IN AN AUTO ACCIDENT	15 out of 100,000	19 out of 100,000

AREA A AREA B

3 2 1 0 1 2 3

Strongly prefer — About the same — Strongly prefer

You preferred Area B. In the next screen, I will RAISE your chance of CHRONIC BRONCHITIS in Area B from 55 to 60 out of 100,000. Think about how your preference rating would change.

PRESS ANY KEY TO CONTINUE...

Question Number 59

Remember that CURRENTLY
-- YOUR chance of CHRONIC BRONCHITIS is 100 out of 100,000 every year
-- YOUR chance of an AUTO DEATH is 20 out of 100,000 every year

WHICH AREA DO YOU PREFER?

YOUR CHANCE	AREA A	AREA B
OF CHRONIC BRONCHITIS	75 out of 100,000	60 out of 100,000
OF DYING IN AN AUTO ACCIDENT	15 out of 100,000	19 out of 100,000

AREA A AREA B

3 2 1 0 1 2 3

Strongly prefer — About the same — Strongly prefer

MOVE CURSOR WITH ARROW KEYS....THEN PRESS ENTER OR X TO REDO...

Question Number 60

Remember that CURRENTLY
-- YOUR chance of CHRONIC BRONCHITIS is 15 out of 100,000 every year
-- YOUR chance of an AUTO DEATH is 20 out of 100,000 every year

WHICH AREA DO YOU PREFER?

YOUR CHANCE	AREA A	AREA B
OF CHRONIC BRONCHITIS	75 out of 100,000	65 out of 100,000
OF DYING IN AN AUTO ACCIDENT	15 out of 100,000	19 out of 100,000

AREA A AREA B

3 2 1 0 1 2 3

Strongly prefer — About the same — Strongly prefer

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER OR X TO REDO...

Question Number 61

Remember that CURRENTLY
-- YOUR chance of CHRONIC BRONCHITIS is 100 out of 100,000 every year
-- YOUR chance of an AUTO DEATH is 20 out of 100,000 every year

WHICH AREA DO YOU PREFER?

YOUR CHANCE	AREA A	AREA B
OF CHRONIC BRONCHITIS	75 out of 100,000	70 out of 100,000
OF DYING IN AN AUTO ACC!DENT	15 out of 100,000	19 out of 100,000

AREA A AREA B

3 2 1 0 1 2 3

Strongly prefer — About the sase — Strongly prefer

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER OF X TO REDO

Question Number 12

Remember that CURRENTLY
-- YOUR chance of CHRONIC BRONCHITIS is 100 out of 100,000 every year
-- YOUR chance of an AUTO DEATH is 20 out of 100,000 every year

WHICH AREA DO YOU PREFER?

YOUR CHANCE	AREA A	AREA B
OF CHRONIC BRONCHITIS	75 out of 100,000	72 out of 100,000
OF DYING IN AN AUTO ACCIDENT	15 out of 100,000	19 out of 100,000

AREA A AREA B

3 2 1 0 1 2 3

Strongly prefer — About the same — Strongly prefer

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER OR X TO REDO...

Question Number 13

Remember that CURRENTLY
-- YOUR chance of CHRONIC BRONCHITIS is 100 out of 100,000 every year
-- YOUR chance of an AUTO DEATH is 20 out of 100,000 every year

WHICH AREA DO YOU PREFER?

YOUR CHANCE	AREA A	AREA B
OF CHRONIC BRONCHITIS	75 out of 100,000	73 out of 100.000
OF DYING IN AN AUTO ACCIDENT	15 out of 100,000	19 out of 100,000

AREA A AREA B

3 2 1 0 1 2 3

Strongly prefer — About the same — Strongly prefer

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER OR X TO REDO...

Question Number 54

Remember that CURRENTLY
-- YOUR chance of CHRONIC BRONCHITIS is 100 out of 100,000 every year
-- YOUR chance of an AUTO DEATH is 20 out of 100,000 every year

WHICH AREA DO YOU PREFER?

YOUR CHANCE	AREA A	AREA B
OF CHRONIC BRONCHITIS	75 out of 100,000	74 out of 100,000
OF DYING IN AN AUTO ACCIDENT	15 out of 100,000	19 out of 100,000

AREA A AREA B

3 2 1 0 1 2 3

Strongly prefer — About the same — Strongly prefer

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER OR X TO REDO...

Question Number 55

Remember that CURRENTLY
-- YOUR chance of CHRONIC BRONCHITIS is 100 out of 100,000 every year
-- YOUR chance of an AUTO DEATH is 20 out of 100,000 every year

WHICH AREA DO YOU PREFER?

YOUR CHANCE	AREA A	AREA B
OF CHRONIC BRONCHITIS	75 out of 100,000	75 out of 100.000
OF DYING IN AN AUTO ACCIDENT	15 out of 100,000	19 out of 100,000

AREA A AREA B

3 2 1 0 1 2 3

Strongly prefer — About the same — Strongly prefer

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER OR X TO REDO...

Question Number 47

WHICH AREA DO YOU PREFER?

YOUR CHANCE	AREA A	AREA B
OF CHRONIC BRONCHITIS	75 out of 100,000	75 OUT OF 100,000
OF DYING IN AN AUTO ACCIDENT	15 OUT OF 100,000	19 out of 100,000

AREA A AREA B

YOU PREFERRED AREA B EVEN THOUGH AREA A IS BETTER ON AUTO DEATH AND BOTH AREAS ARE THE SAME ON CHRONIC BRONCHITIS.

I AM GOING TO ASK YOU TO ANSWER THESE QUESTIONS AGAIN.

PRESS ANY KEY...

Question Number 48

Remember that CURRENTLY
-- YOUR chance of CHRONIC BRONCHITIS is 100 out of 100,000 every year
-- YOUR chance of an AUTO DEATH is 20 out of 100,000 every year

WHICH AREA DO YOU PREFER?

YOUR CHANCE	AREA A	AREA B
OF CHRONIC BRONCHITIS	75 out of 100,000	55 out of 100,000
OF DYING IN AN AUTO ACCIDENT	15 out of 100,000	19 out of 100,000

AREA A AREA B

3 2 1 0 1 2 3

Strongly prefer — About the same — Strongly prefer

You prefer Area A. In the next screen, I will DECREASE your chance of an AUTO DEATH in Area B from 19 to 18 out of 100,000. Think about how your preference rating would change.

PRESS ANY KEY TO CONTINUE

Question Number 69

Remember that CURRENTLY
YOUR chance of CHRONIC BRONCHITIS is 100 out of 100,000 every year
-- YOUR chance of an AUTO DEATH is 20 out of 100,000 every year

WHICH AREA DO YOU PREFER?

YOUR CHANCE	AREA A	AREA B
OF CHRONIC BRONCHITIS	75 out of 100,000	55 out of 100,000
OF DYING IN AN AUTO ACCIDENT	15 out of 100,000	18 out of 100,000

AREA A AREA B

3 2 1 0 1 2 3

Strongly prefer — About the same — Strongly prefer

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER OR X TO REDO...

Question Number 70

Remember that CURRENTLY
-- YOUR chance of CHRONIC BRONCHITIS is 100 out of 100,000 every year
-- YOUR chance of an AUTO DEATH is 20 out of 100,000 every year

WHICH AREA DO YOU PREFER?

YOUR CHANCE	AREA A	AREA B
OF CHRONIC BRONCHITIS	75 out of 100,000	55 out of 100,000
OF DYING IN AN AUTO ACCIDENT	15 out of 100,000	17 out of 100,000

AREA A AREA B

3 2 1 0 1 2 3

Strongly prefer — About the same — Strongly prefer

MOVE CURSOR WITH ARROW KEYS...THEN PRESS ENTER OR X TO REDO...